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PROBLEMS.

19. Proposed by A. L. FOOTE, C. E., No. 80, Broad Street, New York City.

$$\text{Given }\left.\begin{array}{l}\dfrac{xyz}{\sqrt[n]{(x^n+y^n)}}=a\\[2ex]\dfrac{xyz}{\sqrt[n]{(x^n+z^n)}}=b\\[2ex]\dfrac{xyz}{\sqrt[n]{(y^n+z^n)}}=c\end{array}\right\}.\ \text{To find } x,\ y, \text{ and } z.$$

20. Proposed by J. K. ELLWOOD, A. M., Principal of Colfax School, Pittsburg, Pennsylvania.

At what price must the government sell 5% $100 bonds to run 10 years, interest payable annually, to make them equivalent to 3% BONDS AT PAR to run 10 years, interest payable annually? At what price if interest be paid semi-annually?

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GEOMETRY.

Conducted by B. F. FINKEL, Kidder, Missouri. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

6. Proposed by EARL D. WEST, West Middleburg, Logan County, Ohio.

Having given the sides 6, 4, 5, 3 respectively of a trapezium, inscribed in a circle, to find the diameter of the circle.

Solution by Hon. JOSIAH H. DRUMMOND, LL.D., Portland, Maine.

The following solution I discovered (so far as I know) and wrote on the margin of one of the pages in Young's Analytical Geometry containing his solution, January 12, 1873.

Conceive the trapezium, $ABDC$, inscribed in the circle and draw the diagonals. Let $CD=6$, $BD=4$, $AB=5$ and $AC=3$, and AD and BC be the diagonals.

Since the product of the diagonals=the sum of the products of the opposite side (Young's Geom. p. 211) we have $AD\times BC=30+12=42$....(1). Also since $CD\times BD+AB\times AC\ :\ CD\times AC+AB\times BD\ ::\ AD\ :\ BC$. (Young's Geom. p. 212) we have 39 : 38. :: $AD{:}BC$....(2). Substituting in (1) the value of AD as found in (2) we readily find $BC=2\sqrt{\frac{133}{13}}$. In the triangle BCD we have the three sides and readily find area $=\frac{48}{13}\sqrt{10}$. But diameter of circumscribing circle=one-half of the continuous product of three sides divided by area; hence $D=\frac{1}{2}\times6\times4\times2\sqrt{\frac{133}{13}}\div\frac{48}{13}\sqrt{10}=\sqrt{43.225}=65.7457223-$.

7. **Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy in the Ohio University, Athens. Ohio.**

Through each point of the straight line $x=my+h$ is drawn a chord of the parabola $y^2=4ax$, which is bisected in the point. Prove that this chord touches the parabola $(y+2am)^2=8a(x-h)$.

Solution by the Proposer.

Let the chord be $gx+fy=1\ldots.(1)$.

This cuts the curve $y^2=4ax\ldots.(2)$, in the points whose co-ordinates are given by the equations

$$x^2-\frac{2(g+2af^2)}{g^2}x+\frac{1}{y^2}=0\ldots.(3),\text{ and}$$

$$y^2+\frac{4af}{g}y-\frac{4a}{g}=0\ldots.(4).$$

The middle of the chord is then $\left(\frac{g+2af^2}{g^2},-\frac{2ag}{f}\right)$.

If this point be on the line $x=my+h\ldots.(5)$,

$$\frac{g+2af^2}{g^2}=-\frac{2amf}{g}+h\ \ldots(6),$$

$$\text{or, } g+2af^2=-2amfg+hg^2\ldots.(7).$$

Making this homogeneous by aid of (1),

$$(h-x)\frac{g^2}{f^2}-(y+2am)\frac{g}{f}-2a=0\ldots.(8),$$ a quadratic in the undetermined constant $\frac{g}{f}$, and giving the envelope $(y+2am)^2=8a(x-h)$.

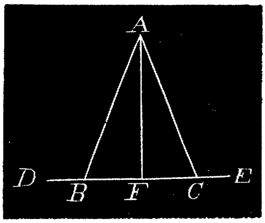
Also solved by *L. E. Pratt*, *Alfred Hume*. *G. B. M. Zerr*, and *J. F. W. Scheffer*.

8. **Proposed by ADOLPH BAILOFF, Durand, Wisconsin,**

If the two exterior angles at the base of a triangle are equal, the triangle is isosceles.

Solution by MISS GRACE H. GRIDLEY, Student in Kidder Institute, Kidder, Missouri; and P. S. BERG, Apple Creek, Ohio.

Let the exterior angles, ABD and ACE of the triangle ABC be equal. To prove the triangle isosceles.



PROOF: $<ACE+<ACF=2$rt.$<s$.

Also $<ABD+<ABF=2$rt.$<s$.

$\therefore\ <ACE+<ACF=<ABD+<ABF$.

(Things equal to the same thing are equal to each other).

But $<ACE=<ABD$. (HYP.)

$\therefore<ACF=<ABF$.

(If equals be subtracted from equals, the remainders are equal).